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ABSTRACT

This curriculum guide provides ideas for implementing technology education in grades 7-12. It assumes a basic understanding of the four clusters of manufacturing, construction, communications, and power/transportation and is meant to supplement and reorganize this approach with up-to-date information and activities. One way to present a variety of technological concepts in industrial arts is outlined. A technology education task list that groups the tasks into six modules follows. The module titles are: computer applications in technology; automation, robotics, and industrial practices; light, lasers, and fiberoptics; communication technology; technology/academic correlation; and future technology. An outline provides an overview of how technology education can be integrated into the four cluster approach. Each supporting objective is listed according to related cluster areas. Another outline lists tasks under the six modules. A performance objective and enabling objectives are given for each task. Appendixes include a glossary of computer terms for technology education, a list of suggested resources and related materials on implementation of a technology education program, an introduction to robotics for technology education instructors, and a communications model. (YLB)

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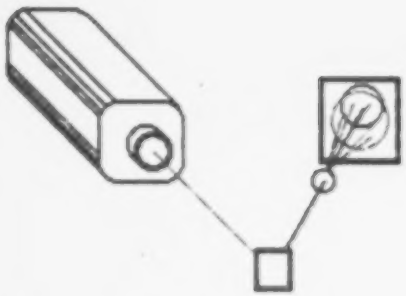
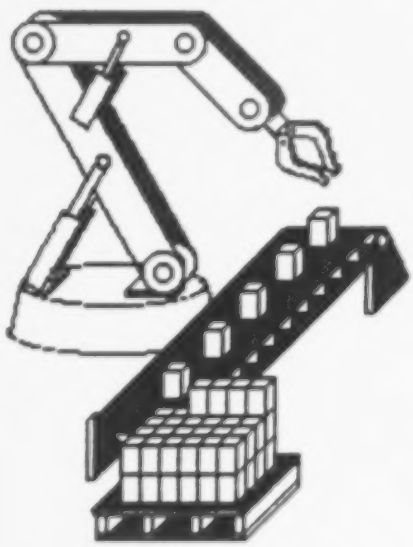
TECHNOLOGY EDUCATION





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A CURRICULUM GUIDE
BY BRAD THODE FOR THE
IDAHO STATE DIVISION OF VOCATIONAL EDUCATION

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Technology Education Curriculum Guide

by Brad Thode

INTRODUCTION

Technological literacy is a basic skill needed for all students to succeed in a technology-based society. The national trend away from traditional industrial arts toward technology education is being studied in many states and mandated in some. Idaho Industrial Arts instructors are indeed fortunate to be given the opportunity to mold the future through the Industrial Arts Grant Award Program and various curriculum development projects administered by the Division of Vocational Education. It is hoped that this guide will be used by instructors to evaluate the relative importance of current curriculum content in the light of rapid technological growth and occupational changes.

The fact that the knowledge base doubles every four years will make all curriculum guides obsolete eventually; this guide is no exception. The realization that curriculum must be up-dated and re-evaluated periodically should not be a discouraging characteristic of teaching, rather, it should help to keep teacher enthusiasm and involvement at a high level. This guide is written to include the latest information available. The content of modules 1-5 will require annual evaluation and up-grading to assure that they represent state-of-the-art information. Module 6 is designed to be open-ended and continually adaptable to reflect the advancements in technology.

ACKNOWLEDGMENTS

This document would not have been possible without the cooperation and assistance of the Idaho State Division of Vocational Education and the support of Blaine County School District Number 61. Specifically, the following individuals have provided resources and encouragement which are greatly appreciated.

LOCAL

- Dr. David Noonan, Superintendent, Blaine County School District Number 61.
- Mr. Charles Turner, Principal, Wood River Junior High

School
- Mr. Raymond Grosvenor, Vice Principal, Wood River Junior High School
- Mr. Philip Homer, Principal, Wood River High School

STATE
- Dr. William Ullery, State Administrator, Idaho State Division of Vocational Education
- Dr. Donald Eshelby, Director of Program Services, Idaho State Division of Vocational Education
- Mr. Donald Taylor, Supervisor, Industrial Technology Education, Idaho State Division of Vocational Education

INVITATION

The implementation of a new curriculum need not be a lonely undertaking. Many traditional industrial arts teachers all over the country are facing the same problems and challenges. Traditionally, industrial arts teachers have been known for their ability to design, invent, improvise, adapt, and scrounge. This transition period provides an ideal opportunity for us to live up to our reputation. Many resources are available to assist the instructor in the study of technology. Perhaps the most effective of which is simply sharing information. In an effort to make the change to technology education as painless as possible, these two suggestions are offered for your consideration.

1. Join the International Technology Education Association.
   - You will be provided with current technology-related information each month through The Technology Teacher journal and qualify for all of the benefits of association membership.
   - You will be supporting an organization committed to the growth and development of technology education.

   CONTACT:
   International Technology Education Association
   1914 Association Drive
   Reston, VA 22091
   [$40 Annual Professional membership fee]
2. Visit the Technology Education Program at Wood River Junior High School.
   - Many concepts are best learned by hands-on participation.

By visiting the program and seeing it in action, you can get ideas and adapt them to your program.

• Everyone can benefit from the sharing of activity sheets, safety suggestions, public domain software, and most of all, ideas.

CONTACT:

Wood River Junior High
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P.O. Box 1088
Hailey, ID 83333
(208) 788-3523

SCOPE

The presentation of technology-related information must start at an early age. Students need to be aware of the effects of technology on their lives and their futures. The ability to adapt to changes brought about by technological advancements is also an important concept to teach. As the introduction of computers in schools has proven, youth can often accept and learn the new technology easier than many adults. It is suggested, therefore, that an attempt be made to present a formal technology education program in the elementary school.

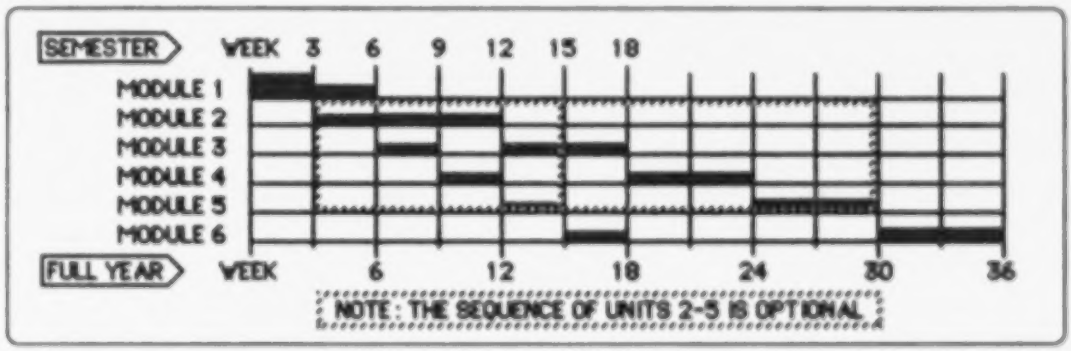
This curriculum guide is an attempt to provide ideas for implementing technology education in grades seven through twelve. All of the tasks and their associated activities presented below have been tested and used successfully in both the junior and senior high schools.

The four clusters of Manufacturing, Construction, Communications, and Power/Transportation have proven to be a logical presentation technique for representing various aspects of industry. This technology education curriculum assumes a basic understanding of the cluster areas. Many cluster area curriculum guides are available (form Idaho and other states) which can help those instructors who are unfamiliar with the basic concepts of the cluster approach. This guide will not attempt to include the basic four cluster curriculum, rather, it is meant to supplement and reorganize this time-tested approach with up-to-date information

and activities.

SEQUENCE

The study of technology can be integrated into any existing curriculum. The following task outline represents one way to present a variety of technological concepts in industrial arts. The program consists of six modules related to technology. Each module contains six technology-related tasks. The time allotted to each task will vary; however, each module is designed to last for a three or six-week period depending on the total length of the course. The six modules combined constitute either a semester-long or a full year program.



All of the Modules contain tasks and activities related to the four clusters of manufacturing, building construction, communications, and power/transportation (see performance objectives for the cluster breakdown.) All six modules contain information related to the four clusters, therefore, added flexibility is gained.

- Instructors currently teaching the four cluster approach, but wishing to up-date and include technology-related activities, will find it easy to implement the tasks in their existing program.
- New instructors, or those currently teaching a traditional program have an additional option:
  1. Start a four cluster program which includes technology-related tasks.
  2. Start a technology based program which is structured around the four clusters as outlined below.

The actual sequence in which the six modules are presented can vary with two exceptions:

- It is very difficult to teach about technology of any type without including information about computers. It is strongly suggested, therefore, that **Module 1- Computer Applications in Technology**, be presented first.
- **Module-6 Future Technology** is designed to give students an opportunity to synthesize and evaluate their study of the other five modules. It should, therefore be presented last.

TECHNOLOGY EDUCATION TASK LIST

The change to technology education from industrial arts should not mean a departure from hands-on activities. A definite change in the *type* of activities assigned to students will be apparent in the following list. A curriculum of this type does not accommodate the large, time-consuming projects often associated with a traditional industrial arts program. Every effort should be made, however, to provide a minimum of 80% of classtime for hands-on activities. Ideas for implementing some of the activities associated with the tasks outlined below are presented in Appendix E.

MODULE- 1 COMPUTER APPLICATIONS in TECHNOLOGY

[See Appendix A: COMPUTER TERMS FOR TECHNOLOGY EDUCATION.]

TASK 1.1: Produce a document through the use of word processing software.

TASK 1.2: Produce a CAD (computer aided drafting) drawing.

TASK 1.3: Design, create, and use a database to organize and retrieve data.

TASK 1.4: Utilize a spreadsheet to estimate project costs and maintain budget information.

TASK 1.5: Demonstrate an understanding of computer graphics and desktop publishing by producing a technology-

related document.

TASK 1.6: Demonstrate a basic understanding of computer programming by entering, debugging and running a program.

MODULE- 2 AUTOMATION, ROBOTICS, and INDUSTRIAL PRACTICES

[See Appendix C: ROBOTICS and introduction for technology education instructors.]

TASK 2.1: Design and construct a simulation of an industrial robotic application.

TASK 2.2: Design and construct a simulated industrial robot arm which illustrates the use of fluid power and simple machines.

TASK 2.3: Interface a computer and a robot or utilize a computer to control external devices.

TASK 2.4: Simulate the movement and storage of hazardous materials.

TASK 2.5: Simulate industrial materials handling techniques.

TASK 2.6: Analyze the school lab with regard to safety.

MODULE- 3 LIGHT, LASERS AND FIBEROPTICS

TASK 3.1: Conduct experiments which illustrate the electromagnetic spectrum.

TASK 3.2: Research and report on the development, uses, and potential applications of lasers.

TASK 3.3: Conduct experiments with laser light which illustrate properties of light.

TASK 3.4: Create a laser hologram.

TASK 3.5: Send a voice transmission over fiberoptic cable

through a modulated laser

TASK 3.6: Research, design, and set up a simulation of an industrial laser application.

MODULE- 4 COMMUNICATION TECHNOLOGY

TASK 4.1: Apply basic electronic laws and principles by setting up and explaining analog and digital circuits

TASK 4.2: Demonstrate an understanding of photographic techniques and processes

TASK 4.3: Demonstrate an understanding of offset lithography including design, layout, linecopy negative preparation, stripping, plate making, printing, and binding

TASK 4.4: Create a video presentation which illustrates a technology-related concept.

TASK 4.5: Demonstrate an understanding of communication satellite technology and telephone systems

TASK 4.6: Access a commercial database or bulletin board service

MODULE- 5 TECHNOLOGY/ACADEMIC CORRELATION

TASK 5.1: Apply general math and algebra assignments in the solution of technology-related problems

TASK 5.2: Solve science and technology-related problems by applying problem solving techniques and the scientific method.

TASK 5.3: Incorporate reading and writing skills in the study of technology.

TASK 5.4: Utilize the skills related to speech or drama by communicating a technology-related topic to a group.

TASK 5.5: Present social studies or current events topics through the use of video and computer technology.

TASK 5.6: Describe how technology influences and relates to all of the classes taught in school.

MODULE- 6 FUTURE TECHNOLOGY

TASK 6.1: Design and conduct a simulation of Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM).

TASK 6.2: Design and construct a model of a futuristic structure.

TASK 6.3: Construct and perform an experiment related to future transportation techniques.

TASK 6.4: Construct a test sample and test the strength-to-weight ratio of composite materials.

TASK 6.5: Demonstrate an understanding of aerodynamics by conducting wind tunnel experiments.

TASK 6.6: Synthesize and evaluate the study of technology, make a report of possible future predictions in the fields of world politics, medicine, transportation, communication, manufacturing, construction, world hunger, population, and space.

SUPPORTING OBJECTIVES and CLUSTER CORRELATION

The following outline is provided to give an overview of how technology education can be integrated into the four cluster approach. Each of the supporting objectives are listed according to related cluster areas. For convenience, the supporting objectives for the cluster areas are listed under each of the technology modules. These objectives provide background information and skills for the tasks listed above. Specific tasks are referenced as required.

MODULE- 1 COMPUTER APPLICATIONS in TECHNOLOGY

[See Appendix A. COMPUTER TERMS FOR TECHNOLOGY EDUCATION.]

All Clusters

1.1 Define the major computer terms and use them in context related to technology.
1.2 Identify the components of a microcomputer system and describe their use.
1.3 Describe the effects of increasing computer use on society.
1.4 Identify the limitations and possible problems associated with a computer-based society.
1.5 Relate computer understanding to possible career goals.
1.6 Express ethical obligations and appropriate values related to the legal use of computer hardware and software.
1.7 Use career assessment software to evaluate interest areas and possible career opportunities.
1.8 Demonstrate a working knowledge of safety procedures through the use of safety related software.

Communications Technology

1.9 Produce a three-view drawing using CAD (Computer Aided Drafting) software [see TASK 1.2.]
1.10 Demonstrate basic skills in the use of word processing software by producing a printed document (report) with text and graphics [see TASK 1.1.].
1.11 Plot a working drawing with CAD software.
1.12 Digitize a printed or continuous tone original into a computer graphic image [see TASK 1.5.].
1.13 Connect with an on-line database through communications software and a modem [see TASK 4.6.].

Manufacturing Technology

1.14 Illustrate the use of spreadsheet software by producing a bill of materials for a manufacturing prototype [see TASK 1.4.].

1.15 Utilize database software to keep an inventory of manufactured parts in a mass production activity [see TASK 1.3.].

1.16 Produce a break-even chart for a student company using computer graphics [see TASK 1.5.].

1.17 Set-up and operate a CAM (Computer Aided Manufacturing) simulation with the proper hardware and software [see TASKS 2.3, and 6.1.].

Building Construction Technology

1.18 Develop a spreadsheet to estimate a proposed building project [see TASK 1.4.].

1.19 Use CAD software to produce and plot a floorplan for a house [see TASK 1.2.].

1.20 Describe the advantages of word processing in generating building specifications [see TASK 1.1.].

Power and Transportation Technology

1.22 Use CAI (Computer Aided Instruction) software to accurately determine the heat loss of a house.

1.23 Use CAI software to learn to read a micrometer.

1.24 Use CAI software to study resistor color codes.

1.25 Use CAI software to apply Ohm's Law to electrical circuits.

1.26 Identify and describe the four cycles of a four stroke-cycle engine through the use of software using computer graphics.

1.27 Demonstrate a working knowledge of basic digital and analog electronics principles [see TASK 4.1.].

1.28 Compute automobile costs such as purchase price, maintenance costs and fleet records.

MODULE- 2 AUTOMATION, ROBOTICS, and INDUSTRIAL PRACTICES

[See Appendix C: ROBOTICS: and introduction for technology education instructors.]

All Clusters

2.1 Describe the effect of increased use of robotics on jobs of the future.
2.2 Describe the limitations and abilities of industrial and domestic robots.
2.3 Name and describe various robotic power supplies i.e. pneumatic, hydraulic, electronic [see TASKS 2.2, and 4.1.].
2.4 Identify the industrial applications of robotics, i.e., pick and place, spot welding, spray painting, etc... [see TASK 2.1.]
2.5 Operate and program an educational robot to perform a pick and place maneuver [see TASK 2.1.].
2.6 Given a list of robot accomplishments, distinguish between fact and fiction.
2.7 Brainstorm possible domestic robot applications listing advantages and disadvantages.

Communications Technology

2.8 Define the terms related to data transmission between computers and robots [see TASK 6.1.].
2.9 Download current industrial robot information from an on-line database.

Manufacturing Technology

2.10 Describe the application of robots in the production of products.
2.11 Program an educational robot to simulate an industrial application [see TASK 2.1.].
2.12 Experiment with robotic vision and voice recognition.
2.13 Simulate robotic warehousing and inventory retrieval systems [see TASK 2.4.].
2.14 Investigate materials handling techniques as they apply them to mass production sequences [see TASK 2.5.].

Building Construction Technology

2.15 Describe the possible use of robotics in the construction of undersea and space construction.

Power and Transportation Technology

2.16 Research robotic applications in space and undersea applications.
2.17 Experiment with computer control of peripheral devices

such as micro-switch status, motor speed and direction, etc [see TASKS 6.1, and 2.1.]

2.18 Construct a simulated robot arm using simulated hydraulics and pneumatics [see TASK 2.1.]

MODULE- 3 LIGHT, LASERS and FIBEROPTICS

All Clusters

3.1 Describe the scientific theory related to the production of laser light [see TASK 3.2.].

3.2 Describe the application of lasers in the fields of communications, defense, medicine, and industry [see TASK 3.2.]

3.3 Explain the safety rules related to the proper use of lasers

3.4 Describe the production and practical use of laser holography [see TASK 3.4.]

Communications Technology

3.5 List the advantages of fiber optic communications over conventional methods [see TASK 3.5.]

3.6 Send a voice transmission over fiber optic cable through a modulated laser [see TASK 3.5.]

3.7 Send a video or voice message through the air via modulated laser light [see TASK 3.5.]

3.8 Illustrate a working understanding of frequency measurement with a signal generator and an oscilloscope

3.9 Produce a laser hologram [see TASK 3.4.]

Manufacturing Technology

3.10 Describe the use of lasers for industrial cutting and welding [see TASK 3.2.]

3.11 Design a "factory of the future" which utilizes robotics, computers, lasers, and other high tech equipment [see TASK 6.1.]

3.12 Explain the practical applications of fiber optics in the areas of industry, medicine, and defense [see TASK 3.2.]

Building Construction Technology

3.13 Construct a laser-level system to illustrate laser usage in the construction field.

3.14 Prepare a written or oral report on the installation of fiber optic communication systems in large commercial construction projects.

Power and Transportation Technology

3.15 Describe the use of lasers in experiments attempting to reproduce a fusion reaction.

3.16 Describe the electronic operation of a laser [see TASK 3.2.].

MODULE- 4 COMMUNICATION TECHNOLOGY

All Clusters

4.1 Explain how satellite technology has increased communications with remote areas of the world [see TASK 4.5.].

4.2 Explain how the geostationary orbit of communication satellites make global communication networks possible [see TASK 4.5.].

4.3 Define the Clarke belt and identify various satellites used for commercial communication [see TASK 4.5.].

4.4 Identify the basic components of a satellite Television Receive Only (TVRO) earth station [see TASK 4.5.].

4.5 Define appropriate terms related to the telecommunications industry.

Communications Technology

4.6 Operate a satellite receiver and dish drive to receive a satellite TV signal [see TASK 4.5.].

4.7 Locate various communications satellites using satellite receiving equipment and proper references [see TASK 4.5.].

4.8 Identify various types of data transmissions received from satellite signals other than TV [see TASK 4.5.].

4.9 Produce an illustrated drawing of a satellite communications system including both uplink and downlink operations [see TASK 4.5.].

4.10 Draw a parabolic curve, and describe its characteristics related to satellite dishes.

Manufacturing Technology

4.11 Describe how satellite shopping programs and telecommuni-

cation retail sales techniques could change marketing concepts.

MODULE- 5 TECHNOLOGY/ACADEMIC CORRELATION

All Clusters

5.1 Utilize instructional technology equipment and techniques to produce a high quality report [see TASK 1.1].
5.2 Prepare a written report through on-line telecommunication techniques [see TASK 4.6].
5.3 Demonstrate keyboarding skills for accuracy and speed.
5.4 Produce an assignment using word processing software [see TASK 1.1].
5.5 Describe the application of math skills in the solving of technology related problems [see TASK 5.1].

Communications Technology

5.6 List the various media through which communication can take place.
5.7 Evaluate the advantages and disadvantages of various communication media.
5.8 Apply the communication model to communication problems in school.

Manufacturing Technology

5.9 Make a list of technology-related formulas with explanations [see TASK 5.1].
5.10 Make a list of geometry theorems related to drafting techniques and practices [see TASK 5.1].

Building Construction Technology

5.11 Calculate the area of a house and determine heatloss [see TASK 5.1].
5.12 Apply geometry theorems to the structural design of residential and commercial building components.

Power and Transportation Technology

5.13 Determine power, wattage, horsepower, and engine displacement [see TASK 5.1].
5.14 Apply formulas for the conversion of English and SI units related to engines (i.e., inches to centimeters, Cubic centimeters to cubic inches...etc.)

MODULE- 6 FUTURE TECHNOLOGY

All Clusters

6.1 Describe the advancements in space travel to date.
6.2 Prepare a written or oral report on current NASA projects related to space [see NASA "Spinoff" publication.]
6.3 Describe the potential advantages and possible disadvantages of genetic engineering.
6.4 Design and conduct an experiment related to bio-technology.

Communications Technology

6.5 Describe current NASA projects related to communications.
6.6 Describe the concept of the world being a "global village."
6.7 Explain how satellite communications has affected third world countries.

Manufacturing Technology

6.8 Simulate current NASA projects related to materials processing and testing.

Building Construction Technology

6.9 Construct a model of a proposed space station [see TASK 6.2].

Power and Transportation Technology

6.10 Research and design an experiment which simulates space flight.

TECHNOLOGY TASKS, PERFORMANCE OBJECTIVES and ENABLING OBJECTIVES

MODULE- 1 COMPUTER APPLICATIONS in TECHNOLOGY

[See Appendix A: COMPUTER TERMS FOR TECHNOLOGY EDUCATION.]

TASK 1.1: Produce a document through the use of word processing software.

PERFORMANCE OBJECTIVE: Given the appropriate computer hardware and word processing software, produce a hardcopy of a document without errors.

ENABLING OBJECTIVES:

1. Initialize a storage disk using the appropriate disk operating system (DOS).
2. Boot a word processing application program [see Appendix B, Technology Education Resources.]
3. Enter text illustrating proper keyboarding skills.
4. Explain and demonstrate the techniques required to edit text, change type style/font, check spelling, combine text and graphics, and change margins/tabs.
5. Save a file on a storage disk for future use.
6. Produce a hardcopy of a document by using the proper commands.
7. Demonstrate the proper set up and use of a dot matrix and/or letter quality printer.
8. Demonstrate the correct shut down procedures for the software and hardware utilized.

TASK 1.2: Produce a CAD (computer aided drafting) drawing.

PERFORMANCE OBJECTIVE: Given the needed computer hardware and CAD software, produce a simple drawing. [The complexity of the first drawing assignment to be determined by the background of the student.]

ENABLING OBJECTIVES:

1. Initialize a storage disk using the appropriate disk operating system (DOS).

2. Boot a CAD application program [see Appendix B, Technology Education Resources.]
3. Produce a pre-determined drawing using proper drawing and editing techniques.
4. Explain the use of various drawing techniques, i.e. circles, fillets, dimensioning, ...etc.
5. Illustrate the proper use of a scale grid in the production of an accutate drawing.
6. Save a drawing on a storage disk for future use.
7. Produce a hardcopy of a drawing by properly using a plotter.
8. Demonstrate the correct shut down procedures for the software and hardware utilized.

TASK 1.3: Design and create, and use a database to organize and retrieve data. [The choice of records to include in the database should be determined by the instructor. Possible subjects might include: supply/equipment inventory, student names and emergency phone numbers, technological advancements by date and name, space flights...etc.]

PERFORMANCE OBJECTIVE: Given the appropriate computer hardware and software, design a database of information with proper field design and a minimum of 10 records.

ENABLING OBJECTIVES:

1. Properly initialize a storage disk using the appropriate disk operating system (DOS).
2. Correctly boot a database application program [see Appendix B, Technology Education Resources.]
3. Design the fields required to organize the data being entered for each record.
4. Enter the pre-determined data using proper keyboarding and editing techniques.
5. Save the data on the appropriate storage disk.
6. Demonstrate the ability to insert, delete, and modify records.
7. Design a report based on the data entered.
8. List the advantages of organizing data in a database.
9. Demonstrate the ability to sort and retrieve data.

10. Print a report of selected fields from sorted records.
11. Demonstrate the correct shut down procedures for the software and hardware utilized.

TASK 1.4: Utilize a spreadsheet to estimate project costs and maintain budget information.

PERFORMANCE OBJECTIVE: Given the appropriate computer hardware and software, design a spreadsheet of information of proper design which contains a minimum of 10 items required for a building construction project.

ENABLING OBJECTIVES:

1. Initialize a storage disk using the appropriate disk operating system (DOS).
2. Boot a spreadsheet application program [see Appendix B, Technology Education Resources.]
3. Design the rows and columns required to organize the data being entered.
4. Demonstrate the ability to enter, edit, insert rows or columns, duplicate, format, and sum data.
5. Illustrate how a total is changed when an entry is changed.
6. List the advantages of manipulating numeric data in spreadsheets.
7. Demonstrate the ability to produce a hardcopy of the spreadsheet using the proper printing commands.
8. Demonstrate the correct shut down procedures for the software and hardware utilized.

TASK 1.5: Demonstrate an understanding of computer graphics and desktop publishing by producing a technology-related document.

PERFORMANCE OBJECTIVE: Given the appropriate computer hardware and graphics software applications, digitize a screened or continuous tone original into a computer graphic image.

ENABLING OBJECTIVES:

1. Properly initialize a storage disk using the appropriate disk operating system (DOS).
2. Correctly boot a computer graphics input application program.
3. Demonstrate a working knowledge of the digitizing hardware by correctly setting up an image to be scanned.
4. Properly focus the scanner or video camera to produce a sharp image.
5. Scan an image.
6. Illustrate the ability to manipulate a scanned image by demonstrating the appropriate editing techniques
7. Save a scanned image to the proper data storage disk.
8. Demonstrate the proper set up and use of a dot matrix printer.
9. Demonstrate the correct shut down procedures for the software and hardware utilized.

TASK 1.6: Demonstrate a basic understanding of computer programming by entering, debugging and running a program.

PERFORMANCE OBJECTIVE: Write a computer program in a low level language (i.e., BASIC, Pascal, Logo,...) from a predetermined goal.

ENABLING OBJECTIVES:

1. Determine a goal for a computer program.
2. Design a flowchart for the program based on the goal.
3. Use appropriate programming format to enter and save the program.
4. Demonstrate the ability to research and solve problems through the use of computer hardware and software documentation.
5. Demonstrate the ability to interpret error messages, list the program, and edit mistakes in syntax (debug).
6. Illustrate how the execution of the program meets the predetermined goal.

MODULE- 2 AUTOMATION, ROBOTICS, and INDUSTRIAL PRACTICES

[See Appendix C: ROBOTICS: and introduction for technology education instructors.]

TASK 2.1: Design and construct a simulation of an industrial robotic application.

PERFORMANCE OBJECTIVE: Given a programmable robot and needed materials, design and construct a device or attachment which simulates an industrial robotic application.

ENABLING OBJECTIVES:

1. Research the application of industrial robots, i.e. spray painting, welding, assembly, pick-and-place, handing of hazardous materials, ...etc.
2. Design a robotic experiment based on the research above.
3. Construct the simulated application peripherals while observing proper design parameters, appropriateness of material choice, and electrical and machine safety.
4. Conduct trials of the experiment, evaluate performance, and make needed modifications.
5. Evaluate the simulation experiment with regard to hard automation techniques, human engineering implications, advantages, and disadvantages.

TASK 2.2: Design and construct a simulated industrial robot arm which illustrates the use of fluid power and simple machines.

PERFORMANCE OBJECTIVE: Given instruction in the design and application of industrial robots; plan, design, experiment, refine the design, and construct a simulated robotic arm that will pick up a pencil and place it in a different location by remote control.

ENABLING OBJECTIVES:

1. Apply a sequence of problem solving techniques in the design

process to refine plans for a robot arm.
2. Demonstrate the appropriate use of materials in the design which illustrate a consideration for the strength to weight ratio, cost, operation life, and environmental re-cycleability.
3. Demonstrate general lab safety rules and specific safety rules related to the operation of the machines required for the construction of the robot arm.
4. Identify the work envelope of the robot arm through testing and measurement.
5. Prepare a drawing which illustrates the dimensions of the work envelope.
6. Videotape the testing of the robot arm and evaluate its performance based on the problem statement.
7. Analyze the performance of other robot designs, discuss their advantages and disadvantages.
8. Draw conclusions about the best possible design based on the knowledge gathered.

TASK 2.3: Interface a computer and a robot or utilize a computer to control external devices.

PERFORMANCE OBJECTIVE: Connect a computer and a robot to enable the operation of the robot from a computer, and the storage of robot programming on disk.

ENABLING OBJECTIVES:

1. Describe the difference between serial and parallel data transmission.
2. Identify the components necessary to interface a robot and a computer and describe their function.
3. Demonstrate the ability to manipulate the robot arm via computer.
4. Download a robot program to a computer and save it to disk.
5. Upload a program from disk to the robot.
6. Research the role of robotics in computer aided manufacturing (CAM).

TASK 2.4: Simulate the movement and storage of hazardous

materials.

PERFORMANCE OBJECTIVE: Set up and operate a video camera to monitor the movement of an educational robot. Operate the robot through a pre-determened pick-and-place maneuver by watching the monitor and avoiding other visual or audio communications.

ENABLING OBJECTIVES:

1. Describe the effect of aperture size on depth of field.
2. Research and simulate the handling of hazardous materials in industry and laboratory biohazards.
3. Identify and apply the communications model [see Appendix D, and Module-4] to the experimental simulations.
4. Synthesize the communications model into at least two different experiments designed to illustrate the importance of avoiding feedback interference.
5. Design and perform a communication experiment which utilizes audio feedback only.
6. Design and perform a communication experiment which utilizes graphic feedback only.
7. Evaluate various forms of communication and describe how they conform to the communication model.

TASK 2.5: Simulate industrial materials handling techniques.

PERFORMANCE OBJECTIVE: Design and construct an industrial materials handling simulation. Test the design through experimentation and refine as needed.

ENABLING OBJECTIVES:

1. Describe the techniques used by industry to move materials.
2. Research and construct a working model of an industrial materials handling technique; i.e. pneumatic conveyors, pipeline, crane, conveyor belt, screw conveyor, roller conveyor, vibrating conveyor, gravity conveyor, overhead conveyor, robot,.. etc.
3. Report on the safety considerations related to materials

handling, apply the safety regulations to the school lab.
4. Evaluate the performance of a materials handling simulation to determine its maximum capacity.
5. List suggestions for improvements in efficiency.
6. Research human design considerations for materials handling systems.
7. Describe the activities of assembly line workers listing advantages and disadvantages.

TASK 2.6: Analyze the school lab with regard to safety.

PERFORMANCE OBJECTIVE: Using the Idaho Safety Guide [VOC ED 223] and other resources [see Appendix B, Technology Education Resources], evaluate all aspects of accident prevention in the school lab.

ENABLING OBJECTIVES:

1. Describe the Industrial Technology eye safety program and safety record.
2. Evaluate the use [or availability] of machine guards.
3. List the safety tests and handout materials given to each student.
4. Evaluate the status of the lab first aid kit for treating possible shop accidents.
5. Design and construct a safety poster [computer graphics may be utilized.]
6. Apply industrial safety standards to school practices and facility design.
7. Investigate industrial color coding standards and apply them to the school lab.
8. Research industrial materials storage and handling safety practices and apply them to the school lab.
9. Design and make a computer database of lab accidents.
10. Sort and report the data to determine the most common type of accident.
11. List possible prevention measures designed to avoid further accidents.
12. Analyze the lab clean-up procedures for safety practices and efficiency.

MODULE- 3 LIGHT, LASERS AND FIBEROPTICS

TASK 3.1: Conduct experiments which illustrate the electromagnetic spectrum.

PERFORMANCE OBJECTIVE: Given the appropriate equipment, conduct experiments related to illustrating frequency, wave, and photon theory.

ENABLING OBJECTIVES:

1. Illustrate the color spectrum of white light with the use of a prism.
2. Demonstrate how the spectrum can be recombined into white light with a second prism.
3. Demonstrate reflection of light through the use of a mirror and a protractor to measure the angle of incidence and reflection.
4. Research and report on the principles involved in the use of radar, sonar, and microwaves.
5. Demonstrate wave properties by properly connecting a signal generator to an oscilloscope to illustrate wave form, frequency, wavelength, amplitude, and attenuation.
6. Demonstrate wave properties with a wave tank by illustrating constructive and destructive properties.
7. Illustrate sound waves by connection a radio speaker or microphone to an oscilloscope.
8. Demonstrate the effects of polarized light and nondestructive testing by viewing clear plastic objects through polarized filters.

TASK 3.2: Research and report on the development, uses, and potential applications of lasers.

PERFORMANCE OBJECTIVE: Given appropriate references, research the use of lasers in the fields of industry, medicine, science, space, and defense.

ENABLING OBJECTIVES:

1. Research a topic of interest related to the fields above.
2. Prepare a report on the topic chosen with either of the following options:
    a. Use a combination of word processing and graphic techniques to prepare a report.
    b. Use appropriate techniques to produce a video presentation.
3. Write to a source requesting additional information on one of the topics above.

TASK 3.3: Conduct experiments with laser light which illustrate properties of light.

PERFORMANCE OBJECTIVE: Given a HeNe laser and appropriate equipment, safely conduct experiments which illustrate reflection, refraction, convergence, divergence, coherence, and other properties of laser light.

ENABLING OBJECTIVES:

1. Demonstrate an understanding of the dangers of laser light by passing a written test with 100% accuracy.
2. Illustrate the angles of incidence and reflection with a laser, a mirror, and a protractor.
3. Illustrate refraction by projecting a laser beam through various materials (i.e. water, acrylic, glass, etc ...)
4. Demonstrate the properties of divergence and convergence using laser light and appropriate lenses.

TASK 3.4: Create a laser hologram.

PERFORMANCE OBJECTIVE: Given a 5 mw HeNe laser and appropriate equipment, produce a reflection hologram.

ENABLING OBJECTIVES:

1. Observing safe procedures, set up a vibration dampening table with a laser, spatial filter, front surface mirror, plate

holder, and a light colored object.
2. Expose the holographic plate, develop, bleach and wash under the appropriate safelight conditions.
3. Prepare the finished hologram for viewing under a point source light (i.e. projector light.)
4. Describe the phenomena of the holographic exposure in scientific terms.
5. Experiment with non-destructive holographic testing and transmission holographic techiques.

TASK 3.5: Send a voice transmission over fiberoptic cable through a modulated laser.

PERFORMANCE OBJECTIVE: Given a modulated HeNe laser and appropriate equipment, demonstrate how phone conversations can be sent over fiberoptic cables.

ENABLING OBJECTIVES:

1. Observing proper safety procedures, illustrate the property of internal reflection exhibited by laser light passing through a bent glass rod.
2. Observing proper safety procedures, carefully align a modulated HeNe laser beam through a fiberoptic cable, directing the cable to a photo-detector/amplifier.
3. Send a voice transmission with a microphone connected to the modulated laser and note the amplified sound.
4. Send for information about fiberoptic communications.
5. Describe how a fiberoptic communications system operates.

TASK 3.6: Research, design, and set up a simulation of an industrial laser application.

PERFORMANCE OBJECTIVE: Given a HeNe laser and appropriate equipment, design and conduct a simulation which demonstrates an industrial laser application.

ENABLING OBJECTIVES:

1. Demonstrate how lasers can be used in to monitor the clar-

ity of fluids in industrial processes with a HeNe laser and a photometer.
2. Demonstrate a laser security system using a HeNe laser and a photodetector.
3. Simulate a laser cutting or welding operation.
4. Simulate the use of lasers in quality control using a conveyor and photodetector.

MODULE- 4 COMMUNICATION TECHNOLOGY

TASK 4.1: Apply basic electronic laws and principles by setting up and explaining analog and digital circuits.

PERFORMANCE OBJECTIVE: Given appropriate test equipment and circuit components, design and assemble various circuits that illustrate principles of electricity and electronics.

ENABLING OBJECTIVES:

1. Using an electronics trainer, set up and operate circuits which illustrate the following concepts:
    a. Series/parallel circuits
    b. Ohm's Law
    c. Analog circuits
    d. Digital circuits
    e. Op amp circuits
    f. Integrated circuits
2. Demonstrate DC series and parallel circuits by following a schematic diagram to assemble and operate robot.
3. Demonstrate electro-mechanical components by designing and assembling circuits that utilize motors, speed controllers, solenoids, micro-switches, etc...
4. Demonstrate transducers by designing and assembling various circuits.
5. Demonstrate thermocouples by designing and assembling various circuits.
6. Demonstrate a strobelight by assembling an experiment to measure rate.

TASK 4.2: Demonstrate an understanding of photographic

techniques and processes.

PERFORMANCE OBJECTIVE: Given a 35mm camera, developing and printing equipment, produce black and white and color photographs.

ENABLING OBJECTIVES:

1. Demonstrate an understanding of proper focus, aperture, film speed, and shutter speed camera settings.
2. Properly develop black and white and color film using the appropriate processing chemistry, temperature and times.
3. Demonstrate composition, contrast, color balance, and print processing techniques by producing a photograph.

TASK 4.3: Demonstrate offset lithography including design, lay-out, linecopy negative preparation, stripping, plate making, printing, and binding.

PERFORMANCE OBJECTIVE: Given the appropriate equipment and supplies, properly complete an offset printing project.

ENABLING OBJECTIVES:

1. Demonstrate the ability to produce an original design for offset duplication with proper balance and form.
2. Expose and develop a linecopy negative using a process camera.
3. Expose, flash, and develop a halftone negative using a process camera and contact screen.
4. Demonstrate proper techniques in the stripping of a negative into a flat.
5. Expose and develop an offset plate.
6. Demonstrate proper press preparation and safety techniques in the operation of an offset press to produce acceptable copies.
7. Illustrate the safe use of bindery equipment in the preparation of a finished printing job.

TASK 4.4: Create a video presentation which illustrates a

technology-related concept.

PERFORMANCE OBJECTIVE: Given a video camera, recorder, and related audio and video equipment, produce a video presentation.

ENABLING OBJECTIVES:

1. Demonstrate the proper use of video recording equipment with respect to proper lighting and sound.
2. Design and construct an experiment or simulation related to a technology concept for videotaping.
3. Record a technology simulation or experiment while observing proper operation of the recording equipment demonstrating proper use of wide angle, telephoto, white balance, and fade controls.
4. Illustrate the ability to edit and dub audio signals onto a videotape.

TASK 4.5: Demonstrate an understanding of communication satellite technology and telephone systems.

PERFORMANCE OBJECTIVE: Demonstrate the ability to locate and receive satellite communications with TVRO equipment. Identify the basic components and operation of satellite receiving equipment.

ENABLING OBJECTIVES:

1. Demonstrate the proper use of satellite receiving equipment by finding a predetermined broadcast.
2. Graph the position of all of the Clarke belt satellites whose footprint covers the school's location.
3. Describe the electronic hardware needed for a TVRO system.
4. Describe how signals are uplinked and downloaded.
5. Describe the process of satellite communication as it relates to the basic communication model.
6. Prepare a report on the effects of satellite communication technology on society.

TASK 4.6: Access a commercial database or bulletin board service.

PERFORMANCE OBJECTIVE: Given the appropriate computer hardware and communications software application, access a commercial database or bulletin board service, download data, and send/receive electronic mail.

ENABLING OBJECTIVES:

1. Initialize a storage disk using the appropriate disk operating system (DOS).
2. Boot a communications application program [see Appendix B, Technology Education Resources.]
3. Demonstrate communications hardware by properly setting up a modem and connecting a phone line.
4. Demonstrate computer communications protocol by matching software parameters with those of a BBS or database information service.
    a. Baud Rate
    b. Data Size
    c. Stop Bit(s)
    d. Parity
    e. Handshake
5. Access a BBS or commercial database service with the appropriate log-on information.
    a. Phone link
    b. User indentification
    c. Password
6. Find and download data into RAM.
7. Demonstrate the appropriate sign-off/hang-up procedure.
8. Review the data after sign-off. Save the data on an appropriate storage disk.
9. List the advantages and disadvantages of computer communications.
10. Demonstrate the use of electronic mail by uploading a file, sending the file, and receiving a reply.
11. Utilize a downloaded file in another application, i.e., graphics, BASIC program, word processing, ...etc.

MODULE- 5 TECHNOLOGY/ACADEMIC CORRELATION

TASK 5.1: Apply general math and algebra assignments in the solution of technology-related problems.

PERFORMANCE OBJECTIVE: Given a variety of formulas related to technology, calculate the unknown quantity.

ENABLING OBJECTIVES:

1. Make a list of formulas related to calculating area, volume, velocity, work, power, rate, force, resistance, energy, momentum, and other related quantities.
2. Calculate the unknown quantity in the formulas above by substituting the appropriate quantities for each formula.
3. Distinguish between directly proportional and inversely proportional relationships in various formulas.
4. Apply the formulas listed above using both English and SI units.
5. Enter the formulas listed above on a computer spreadsheet application with appropriate labels.

TASK 5.2: Solve science and technology related problems by applying problem solving techniques and the scientific method.

PERFORMANCE OBJECTIVE: Given a list of industrial processes, analyze each process for science related concepts. Perform industrial/technology processes which illustrate the application of science.

ENABLING OBJECTIVES:

1. Make a list of physical science concepts and related technology applications.
2. List specific technology/industrial applications related to the science areas of physics, chemistry, biology, and earth science.
3. Design and perform experiments or simulations related to

the list above.

TASK 5.3: Incorporate reading and writing skills in the study of technology.

PERFORMANCE OBJECTIVE: Given appropriate reference materials and resources, demonstrate the ability to report experimental data or technology related information.

ENABLING OBJECTIVES:

1. Research a topic related to technology.
2. Synthesize the information into a report utilizing proper grammar and spelling.
3. Report the data collected in an experiment using proper grammar and spelling.
4. Describe the importance of proper language arts skills and apply written communication techniques to the communications model.
5. Demonstrate the proper use of word processing techniques including computer spelling checks.
6. Describe how writing skills are used in each of ten occupations.

TASK 5.4: Utilize the skills related to speech or drama by communicating a technology-related topic to a group.

PERFORMANCE OBJECTIVE: Given appropriate resources, research a technology-related topic for oral presentation to a class.

ENABLING OBJECTIVES:

1. Research a technology-related topic and synthesize the information into notes for an oral presentation.
2. Utilize proper presentation techniques in an oral presentation to a class of students.
3. Participate in a role playing presentation which simulates a technology-related topic.
4. Identify appropriate and inappropriate communication tech-

niques by observing a videotape of your oral presentation.
5. Describe how oral communication skills play an important role in each of ten occupations.

TASK 5.5: Present social studies or current events topics through the use of video and computer technology.

PERFORMANCE OBJECTIVE: Given videotaping equipment, produce a video presentation simulating a newscast.

ENABLING OBJECTIVES:

1. Assign various duties of a news production team to members of the class i.e. reporter, meteorologist, camera operator, sound engineer, sports reporter, editor, graphic designer, etc...
2. Utilize all available resources and equipment in the assigned job, i.e. computer graphics, theme music productions, etc...
3. Prepare notes or cue cards for rehearsals and final presentation.
4. Investigate and utilize any special skills or talents of the class.

TASK 5.6: Describe how technology influences and relates to all of the classes taught in school.

PERFORMANCE OBJECTIVE: Given a list of activities or objectives from various academic and elective courses, identify how a relationship to technology education.

ENABLING OBJECTIVES:

1. Identify how each academic or elective course you are currently taking can help prepare you for a career.
2. Contact two instructors who teach in a grade level four years ahead of and four years behind your current grade. Ask each teacher to list 5 main objectives of their subject area.
3. Make a report which describes how technology education correlates with the list of objectives.
4. Write a description of how your everyday activities would

change without the benefit of technology.
5. Make a videotape or present a role playing activity illustrating a world without technology.
6. Make a list of activities related to the four cluster areas and possible correlation of each activity with other electives or academic courses.

MODULE- 6 FUTURE TECHNOLOGY

TASK 6.1: Design and conduct a simulation of Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM).

PERFORMANCE OBJECTIVE: Given appropriate Computer Aided Manufacturing (CAM) and Computer Integrated Manufacturing (CIM) simulation trainers, design, construct, operate, and evaluate a CAM/CIM experiment.

ENABLING OBJECTIVES:

1. Research how factories of the future may differ from those of today.
2. Describe how just-in-time inventory techniques could help to save time and money.
3. After completion of the CAM/CIM simulation, evaluate how long a pay back period would be required for its implementation.
4. Make a list of the advantages and disadvantages of CAM/CIM implementation.
5. Role play a simulation of the effects of CAM/CIM on society.

TASK 6.2: Design and construct a model of a futuristic structure.

PERFORMANCE OBJECTIVE: Given appropriate resources and materials, design construct and evaluate a variety of possible future structures.

ENABLING OBJECTIVES:

1. Research and report on the advantages and disadvantages of

pneumatic and tensile buildings.

2. Design and construct the largest pneumatic structure possible from a given sheet of plastic film.
3. Research various designs for a permanent space station or moon base.
4. Evaluate the designs and construct plans or a model of your own design. Defend your design in a class presentation.
5. Describe how your house might be constructed differently 50 years from now.
6. Investigate and report on the mass production of modular housing.
7. Construct a model illustrating modular construction techniques.
8. Evaluate how lifestyles might change in this type of shelter.
9. Research and report on the possibility of undersea living.
10. Design and construct a model of an undersea habitation.
11. Evaluate living conditions in such a structure listing advantages and disadvantages.

TASK 6.3: Construct and perform an experiment related to future transportation techniques.

PERFORMANCE OBJECTIVE: Given appropriate resources and materials, design, construct and operate an experimental transportation device.

ENABLING OBJECTIVES:

1. Research and experiment with various alternative energy sources.
2. Research, design, and construct an example of a possible future transportation device; i.e., magnetic levitation, flywheel power, etc...
3. Identify current transportation problems in the world and offer possible solutions with regard to economic and environmental implications.
4. Make a timeline of transportation events in history.

TASK 6.4: Construct a test sample and test the strength-to-weight ratio of composite materials.

PERFORMANCE OBJECTIVE: Given appropriate resources, equipment, and materials, construct test samples of various composite materials for testing.

ENABLING OBJECTIVES:

1. Research the development and production of plywood, particleboard, fiberglass, graphite fiber, and other materials.
2. Make a diagram of the production steps for each material.
3. Research comparison tests of various composite materials.
4. Make a chart of how they compare with regard to strength and weight.
5. Perform the following tests on available material samples:
    a. impact strength
    b. tensile strength
    c. compression strength
    d. thermal conductivity
    e. abrasion resistance
    f. machinability
6. Make a list of how the increased use of composite materials in the manufacturing could change products of the future.
7. Research how manufacturing processes conducted in zero gravity could make a difference in possible materials of the future.
8. Evaluate the current use of various materials used in the construction and manufacturing industries with regard to renewable resources and environmental effects.

TASK 6.5: Demonstrate aerodynamics by conducting wind tunnel experiments.

PERFORMANCE OBJECTIVE: Given a wind tunnel and appropriate equipment, and materials, design and conduct experiments illustrating aerodynamic concepts.

ENABLING OBJECTIVES:

1. Design and conduct an experiment that illustrates Bernoulli's principle.

2. Design and conduct an experiment which illustrates the correlation of design shape and drag force.
3. Design and conduct an experiment which illustrates the principle of lift.

TASK 6.6: Synthesize and evaluate the study of technology; make a report of possible future predictions in the fields of world politics, medicine, transportation, communication, manufacturing, construction, world hunger, population, and space.

PERFORMANCE OBJECTIVE: Given appropriate resources and related background experience in the study of technology, make predictions about possible technological advancements and effects of technology on society.

ENABLING OBJECTIVES:

1. Research 25 important dates in the history of technology starting with the first recorded cave writings up to present day.
2. Make a timeline showing the distribution of events in technology separating the four cluster areas.
3. Extend the timeline above into the next 100 years listing your predictions for advancements in the four clusters.
4. Make a list of possible positive and negative effects of your future predictions.
5. Design and construct a drawing or model of a future home, city, factory, or school.
6. Make a list of 10 ways technology education might help prepare you for the world of the future or a future career.

Appendix A:

COMPUTERS- an introduction for technology education instructors.

The following section is designed to introduce instructors to computer terminology by providing essential information as a foundation for computer understanding. It is strongly recommended that instructors make an effort to become familiar with this section. As computer literacy becomes part of elementary education, the role of secondary instructors is to apply the student's basic literacy to further understanding of industrial and technological applications.

Pre-Test/Post-Test

Those instructors who have had an introduction to computers may wish to test their understanding by taking the two-part test at the end of this section.

Objectives

After completing this unit the you will be able to:

- Define common terms related to computers.
- Convert computer acronyms to their actual meaning.

INTRODUCTION

When people talk about computers it often sounds like a foreign language to those unfamiliar with computer terms. This unit describes the most commonly used terms related to the computer field.

One reason computer terms sound strange at first is because many of the terms are **acronyms**. An acronym is a word made up of the letters of words in a phrase. The word "**Basic**", for example, is the name of the most commonly used computer programming language. "BASIC" is an acronym for "**B**eginner's **A**ll-purpose **S**ymbolic **I**nstruction **C**ode". Many other parts of a computer system use acronyms: CPU, CRT, and I/O for example.

Analog and Digital Computers

An electronic machine that can accept information, process the information, and produce a result is called a **computer.** There are two general types of computers, digital and analog. **Digital** computers are most common. They use voltage pulses to represent a "yes"

or "no" or "1" or "0" condition or signal. This "on or off", two level electronic language uses the **binary** numbering system. The binary numbering system represents all numbers and letters with zeros and ones. The electronic circuits in a computer often use a 5 volt signal to represent a "one" and either a zero voltage (or lower than 5) to represent a "zero". Fortunately, computers handle the conversion from the binary numbering system to the familiar decimal system automatically.

Each of the binary digits that make up the codes for each letter, number, or symbol on a computer keyboard is called a **bit**. The word "bit" is an acronym for **bi**nary digi**t**. Many computers use a combination of eight bits to represent an alphanumeric character. Groups of eight bits make up a complete code called a **byte**. Each byte of information is treated as a single unit by the computer.

Analog computers do not use pulses of electricity. Instead, an analog computer analyzes a continuous flow of electricity. Measurement of temperature, pressure, voltage, etc. is no problem for an analog computer. It is possible for an analog computer to respond to an analog signal. The game **I/O** (input/output) port on many digital microcomputers sends an analog signal of varying resistance to the computer in analog form. Analog computers are important for special applications, but digital computers are much more common. The remainder of this paper will cover digital computers only.

SOFTWARE AND HARDWARE

CPU's and CRT's

One of the most important parts of any computer is the **central processing unit** or **CPU**. Data or information is processed in the CPU of a computer. Mathematical functions such as addition and subtraction, are carried out in a CPU at a very high rate of speed. Information can also be sorted and compared to other data in the CPU. Different computer companies use different CPU's.

The information processed by a CPU is only useful if a person can view it. The video display used on most computer systems is called a **cathode ray tube** or **CRT**. A standard television contains the same type of cathode ray tube, but does not produce the high

resolution image required for computer use. CRT's can be **monochrome** or one color, or may be **composite** color or **RGB** high resolution color for computer graphics.

A basic computer system consists of a keyboard, a CPU, a CRT, and a memory storage device. All of these components are referred to as **hardware.** All of the electronic or mechanical parts of a computer system are grouped into the hardware category. The hardware is not of much use without the proper programming information or list of instructions called **software.** Although most people think of computer disks when they talk about software, it is actually the instructional coding that could come from a variety of hardware sources.

The software instructions can take many forms. Common methods of storing computer data is to put it magnetically on tape, floppy disk, or hard disk. The most common form of magnetic storage is on a floppy disk. Some of the most important software is built into the computer at the factory. This form of software is programmed directly onto the computer chips or integrated circuits (IC's) forming a permanent part of the computer memory. Because this memory is unchangeable, but accessible by the user, it is called **read only memory** or **ROM.** The ROM memory of different computer companies differ. Some computers have only the essential information for a computer to start operation. Other computers have BASIC in ROM. Some computers have application software such as a word processor or a spreadsheet in ROM. Portable computers often have application software in ROM.

The other important part of a computer's memory is used by the operator. Because this memory can be changed at any point, it is called **random access memory** or **RAM.** Programming information stored magnetically on a disk or tape is read into the RAM memory. Data entered into the computer by the user also enters the RAM memory. Unlike ROM, which is not erased when the computer is turned off, RAM is **volatile**. The entire contents of the RAM memory location is erased when the power is turned off or interrupted by accident.

Both RAM and RAM memory capacity is measured in thousands

of bytes. One thousand bytes are called a **Kilobyte** or **K**. A common microcomputer might have a memory capacity of 128K of ROM and 512K of RAM. Although RAM memory capacity is important to the overall usefulness of a computer, it can be saved at any time to a disk to free-up RAM working space.

The hardware device that reads or writes data is called a **disk drive**. Floppy disk drives are the most common. A mass information storage device commonly used is a **hard disk**. Hard disks hold a large quantity of information. Common capacities range from 5 to 80 or more **megabytes**, (1 megabyte = 1 million bytes = 1000K).

Input/Output Devices

There are hundreds of hardware devices that can be connected to a computer to perform specific tasks. This group of computer attachments are called **peripherals**. One of the most common peripheral devices is a printer. Printers are commonly either **letter quality**, or **dot matrix.** Dot matrix printers form letters by printing dots of ink in the proper pattern. Letter quality printers print fully formed letters similar to a typewriter. The speed at which a printer outputs data is measured in **characters per second**, or **CPS.** Dot matrix printers are commonly much faster than letter quality printers. Common speeds for dot matrix printers range from 100-400cps, while letter quality printers print at from 12 to 100 cps. Printers can be designed to print on **tractor feed** paper, or be **sheet fed** as a typewriter. **Laser printers** use laser light to form the printed image at a very high rate. Each type of printer has an advantage for a particular application. Dot matrix and laser printers produce good graphics; letter quality printers give a personal touch to business letters. Type styles and fonts can be changed on most printers. Many letter quality printers use a daisy wheel to produce the printed image.

Where computers are used for business graphics or **computer aided drafting (CAD)**, another type of output is needed. **Plotters** are used to produce accurate drawings, charts, or graphs. Plotters produce images by a computer controlled pen. Some plotters can automatically change pen colors or point widths to produce very precise and attractive graphics.

Computer input can take as many different forms as the variety

of output devices. The computer keyboard is the most common form of input, but not the only method of data entry. CAD systems often use a **digitizing tablet** to enter graphic data. The tablet can internally assign a specific set of coordinates when an electronic pen is touched to a tablet. Another type of graphic input is a **light pen**. Light pens are pointed directly to a CRT screen for graphic input. There are many other forms of computer input. One of the most promising is **voice input**. Although limited in its vocabulary capacity, voice recognition is available for computer use. By speaking into a microphone, a computer equipped with a voice input module can be trained to recognize various vocabulary words or computer commands.

MICRO'S, MINI'S AND MAINFRAMES

The first computers cost millions of dollars, were very large, and used a great amount of electricity to operate. Thanks to the development of the integrated circuit, both the size and cost of computers have decreased greatly. Computers once requiring an entire room full of vacuum tubes and mechanical relays can now fit into the palm of a hand. Large computers are still required to process huge amounts of data. These large systems are called **main frame** computers. They can be connected to many **terminals** that allow many people to use the computer at the same time. Main frame computers are also used by people far away from the computer. Telephone communication between two or more computers is made possible with a **modem**. The term "modem" is an acronym for **mo**dulation and **dem**odulation. The ability of computers to communicate over phone lines makes it possible for **time sharing** on main frame computers.

The great cost of main frame computers kept them out of reach of most small and medium sized businesses. The next step down in the size and cost of a computer is called a **minicomputer**. The minicomputer made it possible for many businesses to have their own computer system rather than time share on a main frame computer. Minicomputers can allow multiple users.

The vast majority of people do not require the computing power of a main frame or minicomputer. The small computer, often called a "personal computer" or "home computer", falls into the

microcomputer category. The ability of microcomputers to quickly process data and to access mainframe or minicomputers make it one of the most versatile and popular computers. Microcomputers make it possible for everyone to have access to computer technology. This paper covers the use of microcomputers but much of the information applies to mini's and mainframes as well.

TECHNICAL TERMS

Time sharing	Binary
Minicomputer	Bit
Acronym	Byte
BASIC	Analog
Computer	Input/Output (I/O)
Digital	Software
Hardware	Central Processing Unit (CPU)
Cathode Ray Tube (CRT)	Monochrome
Composite	RGB (Red Green Blue)
Lightpen	Voice Input
Microcomputer	Main Frame
Modem	Read Only Memory (ROM)
Random Access Memory (RAM)	Volatile Memory
Disk drive	Hard disk
Megabyte	Peripheral
Letter quality	Dot Matrix
Characters Per Second (CPS)	Tractor feed
Sheet Feed	Laser printer
Computer Aided Drafting (CAD)	Plotter
Digitizing Tablet	Kilobyte (K)
Terminal	BBS

REVIEW QUESTIONS

Multiple Choice

1. Which of the following is the smallest?
   a. bit
   b. kilobyte
   c. byte
   d. megabyte

2. Which of the following is treated as one unit by a computer?
   a. bit
   b. kilobyte
   c. byte
   d. megabyte

3. Which of the following is often used to measure the capacity of a hard disk?
   a. bit
   b. kilobyte
   c. byte
   d. megabyte

4. What numbering system is commonly used directly by computers?
   a. binary
   b. hex
   c. decimal
   d. octal

5. Which peripheral device is used to produce accurate drawings?
   a. printer
   b. digitizing tablet
   c. plotter
   d. light pen

6. Which peripheral device is used for business correspondence?
   a. printer
   b. digitizing tablet
   c. plotter
   d. light pen

7. Which of the following peripheral devices can be used for graphic input?
   a. printer
   b. digitizing tablet
   c. plotter
   d. light pen

8. Which type of signal is either on or off?
   a. digital
   b. I/O
   c. analog
   d. RGB

9. Which acronym represents a computer monitor?
   a. CPU
   b. ROM
   c. RAM
   d. CRT

10. Which acronym represents unchangeable memory?
    a. CPU
    b. ROM
    c. RAM
    d. CRT

Completion

1. A type of printer that produces fully formed characters is called a _____ _____ printer.

2. One million bytes of memory is called a _____ .

3. CAD stands for _____ _____ _____.

4. The electrical components of a computer system are called computer_____ .

5. A very large computer system that supports time sharing is called a _____ computer.

6. The most popular microcomputer language is _____ .

7. _____ memory does not get erased when power is interrupted.

8. _____ _____ printer paper has holes on its edges for continuous printing.

9. The general term for computer instructions is _____.

10. The "brain" of a computer is the _____ _____ _____.

Appendix B: Technology Education Resources

The following is a list of suggested resources and related materials which will provide background information for the implementation of a technology education program.

NOTE: This resources list is presented only as a guide to instructors. It is NOT a complete list of all of the resources available nor is it to be considered an endorsement of any product or service. All of the listings, however, have been used by the author and tested with students with varying degrees of success in a technology education program.

COMPUTER REFERENCES

Author	ISBN	Date	Title
Chance	0-8306-1276-9	1981	**Computer Graphics**
Ciarcia	0-07-101963-X	1981	**Ciarcia's Circuit Cellar, Vol 2**
Ciarcia	0-07-010960-5	1979	**Ciarcia's Circuit Cellar, Vol. 1**
Dwyer	0-210-01589-7	1982	**BASIC and the Personal Computer**
Franklin	0-471-09083-2	1982	**Golden Delicious Games for the Apple Computer**
Grillo	0-03-000477-2	1985	**Graphics for the Macintosh**
Guzelimian	0-942386-80-9	1985	**Becoming A Mac Artist**
Hartman	0-932702-69-4	1983	**Computer Graphics**
Katzan	0-442-28419-5	1982	**Microcomputer Graphics & Programming Techniques**
Korites	0-940254-01-8	1981	**Graphic Software for Microcomputers**
Little	0-89303-551-3	1985	**Inside the Apple IIe**
Laurie	0-316-51636-8	1983	**The Joy of Computers**
Margolis	0-8306-0139-2	1983	**Troubleshooting & Repairing Personal Computers**
Myers	0-201-05092-7	1982	**Microcomputer Graphics**
Ralston	0-442-24496-7	1983	**Encyclopedia of Computer Sci. & Eng.**
Roberts	0-13-459461-4	1982	**Industrial Design with Microcomputers**
Rubin	0-914845-67-5	1986	**MS Works on the Apple Mac**
Ryan	0-543-01357-0	1983	**Computer Programming for Graphical Displays**
Trainor	0-938188-25-9	1984	**Computer Literacy Concepts & Applicatons**
Williams	0-89303-315-4	1983	**Apple II Computer Graphics**
Winkler	0-668-05530-8	1983	**The Computer Careers Handbook**
Wolfe	0-8306-2449-X	1982	**Computer Peripherals That You Can Build**
	0-671-06027-9	1983	**Illustrated Computer Dictionary**

ROBOTICS REFERENCES

Author	ISBN	Date	Title
Asimov	0-517-55110-1	1985	**Robots, Machines in Man's Image**
Blankenship	0-13-038324-4	1985	**Apple II/IIe Robotic Arm Projects**
Browing	0-89661-000-4	1978	**Robots On Your Doorstep**
Cardoza	0-8306-1858-9	1985	**Robotics**
Cunningham	0-8306-1077-4	1979	**Handbook of Remote Control Automation Techniques**
Engleberger	0-8144-7587-6	1980	**Robotics In Practice**
Holzbrock	0-442-23154-7	1986	**Robotic Technology Principles and Practice**

Nof	0-471-89684-5	1985	**Handbook of Industrial Robotics**
Osborne	0-910853-00-2	1983	**Robots, An Intro to Basic Concepts and Applications**
Paul	0-262-16082-X	1981	**Robot Manipulators, Math, Programming, & Control**
Scott	0-631-15008-0	1984	**The Robotics Revolution, The Complete Guide**
Susnjara	0-86551-018-0	1982	**Industrial Robots, A Managers Guide**
Warring	0-8306-0673-4	1984	**Robots & Robotology**
Weinstein	0-8104-5192-1	1981	**Android Design**

LASER REFERENCES

Author	ISBN	Date	Title
Hallmark	0-8306-1108-8	1979	**Lasers, The Light Fantastic**
Kock	0-486-24041-X	1981	**Lasers and Holography**
Strong	0-7167-1185-0	1980	**Light and Its Uses**
Mims	0-672-21976-X	1982	**Lightwave Communications**

PRINCIPLES OF TECHNOLOGY/PHYSICS REFERENCES

Author	ISBN	Date	Title
CORD	LC 83-72030	1983	**Unified Technical Concepts, Volume II**
CORD	LC 83-71908	1983	**Unified Technical Concepts, Volume I**
Epstein	0-953218-04-1	1983	**Thinking Physics**
McAlexander	0-8053-7030-7	1979	**Hands-On Applied Physics**
Olenick	0-521-30429-6	1985	**The Mechanical Universe**
Walker	0-471-02984-X	1975	**The Flying Circus of Physics With Answers**
Robinson	0-201-20731-1	1987	**Conceptual Physics**

CONSTRUCTION/STRUCTURES REFERENCES

Author	ISBN	Date	Title
Gordon	0-306-80151-5	1978	**Structures: Or WhyThings Don't Fall Down**
Landels	0-520-04127-5	1978	**Engineering In The Ancient World**
MacGregor	0-688-41997-6	1980	**Bridges, A Project Book**
Salvadori	0-07-054482-4	1980	**Why Buildings Stand Up**
Salvadori	0-689-71039-9	1979	**Building, The Fight Against Gravity**

MANUFACTURING/MATERIALS HANDLING REFERENCES

Author	ISBN	Date	Title
Allegri	0-442-20985-1	1984	**Materials Handling**
Brady	0-07-007069-5	1977	**Materials Handbook**
Gordon	0-691-02380	1976	**The New Science of Strong Materials**
Johnson	87002-141-9	1973	**Manufacturing Processes**

COMMUNICATIONS REFERENCES

Author	ISBN	Date	Title
Bensinger	0-931294-02-9	1979	**The Home Video Handbook**
Clifford	0-8306-1685-3	1984	**The Complete Guide to Satellite TV**
Edelhart	0-02-535000-5	1983	**Omni Online Database Directory**
Hobbs	0-8104-0652-7	1982	**Servicing Home Video Cassette Recorders**
Jones	0-15-307500-7	1986	**Discovering Technology: Communication**

Kuecken	0-8306-1236-X	1980	**Fiberoptics**
Long	0-913390-45-0	1984	**The World of Satellite Television**
Mims	0-672-21976-X	1982	**Lightwave Communications**

SPACE/FUTURE TECHNOLOGY REFERENCES

Author	ISBN	Date	Title
Gatland	0-517-542587	1981	**Space Technology, The Illustrated Encyclopedia of**
Joels	0-345-31881-1	1985	**The Mars One Crew Manual**
Joels	0-345-30321-0	1982	**The Space Shuttle Operator's Manual**
Stine	0-03-070741-2	1985	**Handbook for Space Colonists**
Asimov	0-8253-0225-0	1985	**Living in The Future**
Naisbitt	0-446-51251-6	1982	**Megatrends**
Stableford	0-394-74151-X	1985	**The Third Millennium**
Taylor	0-394-85090-4	1982	**The Kid's Whole Future Catalog**
Well	0-345-31034-9	1982	**The Omni Future Almanac**
	0-553-01264-9	1980	**The Techno/Peasant Survival Manual**

COMPUTER SOFTWARE FOR TECHNOLOGY EDUCATION

MACINTOSH SOFTWARE

Author	Date	Title	Publisher	Application
Kaechler	1984	MacProject	Apple Computer, Inc.	Scheduling
Sauter	1985	Orbiter	Spectrum HoloByte, Inc.	Simulation (Flight)
Snider	1986	SuperPaint	Silicon Beach Software	Graphics/CAD
Wiggington	1984	MacWrite	Apple Computer, Inc.	Word Processing
	1986	Microsoft Works	Microsoft, Corp.	Integrated
	1984	Microsoft BASIC	Microsoft, Corp.	Programming
	1984	Multiplan	Microsoft, Corp.	Spreadsheet
Cutter	1984	MacDraw	Apple Computer, Inc.	CAD
Holmes	1984	MACPLOT		CAD
Boich	1984	MacTerminal	Apple Computer, Inc.	Communications
Artwick	1986	Flight Simulator	Microsoft, Corp.	Simulation (Flight)
King	1985	MacDraft	Innovative Data Design, Inc.	CAD
Newnam	1986	FullPaint	Ann Arbor Software, Inc.	Graphics
	1984	Copy II MAC	Central Point Software, Inc.	Copy
	1983	Jazz	Lotus	Integrated
Balsam	1986	Print Shop	Broderbund Software	Graphics
Bass	1985	Mac 3D	Challenger Software	CAD
Bicakci	1985	Colormate	Softstyle	Graphics (Color)
	1986	Glue	Solutions, Inc.	Utility
Gross	1986	Thunder	Batteries Included	Spelling Checker
	1986	Ready, Set, Go	Manhatten Graphics Corp.	Desktop Publishing
	1985	Excel	Microsoft, Corp.	Spreadsheet
Lundeen	1986	WorksPlus Spell	Lundeen & Associates	Spelling Checker
	1985	MacPascal	Apple Computer, Inc.	Programming
	1985	Switcher	Apple Computer, Inc.	Utility
	1984	DaVinci	Hayden Software	Clip Art
	1984	Mac the Knife	Miles Computing, Inc.	Clip Art
	1986	Smartcom II	Hayes Microcomputer Prod.	Communications
	1986	Turbo Pascal	Borland International	Programming

APPLE II SERIES COMPUTERS

Author	Date	Title	Publisher	Application
Thompson	1982	Copy II Plus	Central Point Software, Inc.	Copy
	1983	AVA	Bell & Howell	Interactive Video
	1984	Robo Cad-1 & 2	Chessell-Robocom Corp.	CAD
Forsythe	1985	CADDRAW	Kitchen Sink Software	CAD
	1979	Heatloss	MECC	Heatloss Calculation
	1984	Bank Street Writer	Broderbund Software	Word Processing
	1981	The Factory	Sunburst Communications, Inc.	CAI
	1983	The Super Factory	Sunburst Communications, Inc.	CAI
	1983	Gears	Sunburst Communications, Inc.	CAI
	1985	The Right Job	Sunburst Communications, Inc.	CAI (Career Info.)
	1985	Microval	Microbot, Inc.	Programming (Robot)
	1982	The Game Show	Advanced Ideas, Inc.	CAI
	1982	AppleWorks	Apple Computer, Inc.	Integrated

Appendix C:

ROBOTICS: an Introduction for Technology Education Instructors

The following section is designed to introduce instructors to robotics by providing essential information as a foundation. It is strongly recommended that instructors make an effort to become familiar with this section and do further research (see Appendix A).

Pre-Test/Post-Test

Those instructors who have had an introduction to robotics may wish to test their understanding by taking the two-part test at the end of this section.

OBJECTIVES

After completing this unit, you will be able to-

- describe the application of robotics in industry.
- program a robot to do a pick-and-place maneuver.
- describe the development of robots from early slave manipulators to the sophisticated robots used today.

INTRODUCTION

The term **robot** can mean different things to different people. An industrial robot can be defined as:

> A reprogrammable manipulator capable of many functions used to move material, tools, or parts in variable programmed motions for various job assignments.

It is important to distinguish a robot from an automated machine. Both are important industrial machine tools, but robots have the capability of being trained to perform different tasks as product designs or tooling requirements change. An automated machine is designed to perform a specific task and cannot be changed easily for a completely different application. This ability of a robot to be easily reprogrammed for a variety of duties make it an efficient machine tool. The same robot can be programmed to spray paint products or reprogrammed to arc weld or assemble parts.

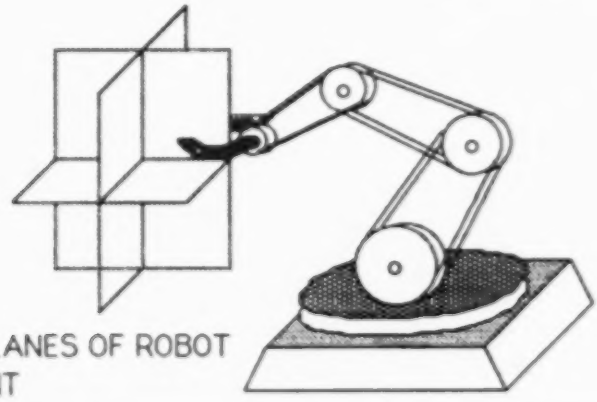
HISTORY

Early "robots" were little more than remote manipulators used to handle hazardous materials from a safe distance. In the 1940's, mechanical linkages were used to mimic the movement of a master controller to a "slave manipulator". The remote arm was often housed inside a "hot cell" where radioactivity levels would be hazardous to humans. Refined models utilized electrical control of the remote arm allowing force feedback so the operator could have a sense of feel or touch. Without the feedback, delicate objects could not be moved without risking damage. The next advance in technology was a wireless remote controlling unit which made it possible to separate the "master" and the "slave" greater distances.

Manipulators of this type were not really robots. Computer controlled robots were first used in industry in 1961. Many advances have been made in both the computer and robotics field.

Most robots can incorporate some type of "hand" called a **gripper** or **end effector**. The use of the "hand" often includes the ability to move in three planes, figure 1.

FIGURE 1

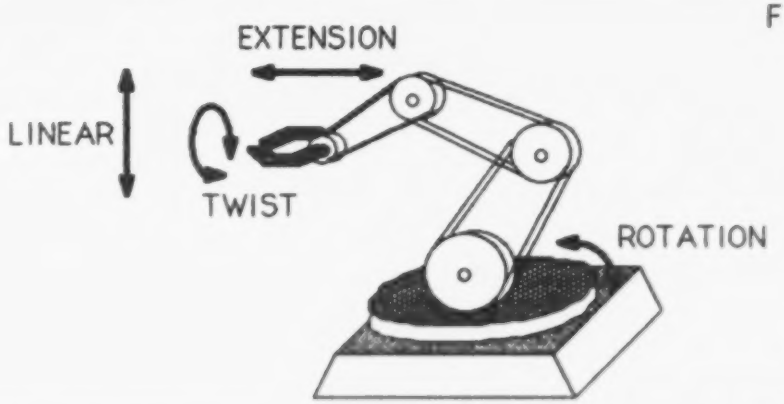


THREE PLANES OF ROBOT MOVEMENT

The gripper is often attached to a "wrist" and an "arm" to allow greater movement capability. The arm can be attached to a rotating base adding another degree of freedom. Many different designs exist for various industrial applications.

Industrial robots are classified in different ways. One classification method describes various robots according to their movement ability. The movements most common to robots are linear, extension, rotation, and twisting. The movements, or flexibility of industrial robots depend on the application. Flexibility and dexterity would be needed for delicate assembly such as the manufacturing of watches or electronic components. The lifting capacity of a robot and its maximum reaching distance are also important considerations. The maximum reach area of a robot is called the **work envelope.** Mechanical or electrical 'stops' are often provided to restrain the movement of each joint to a maximum position. Figure 2 illustrates the four basic movements of industrial robots.

FIGURE 2



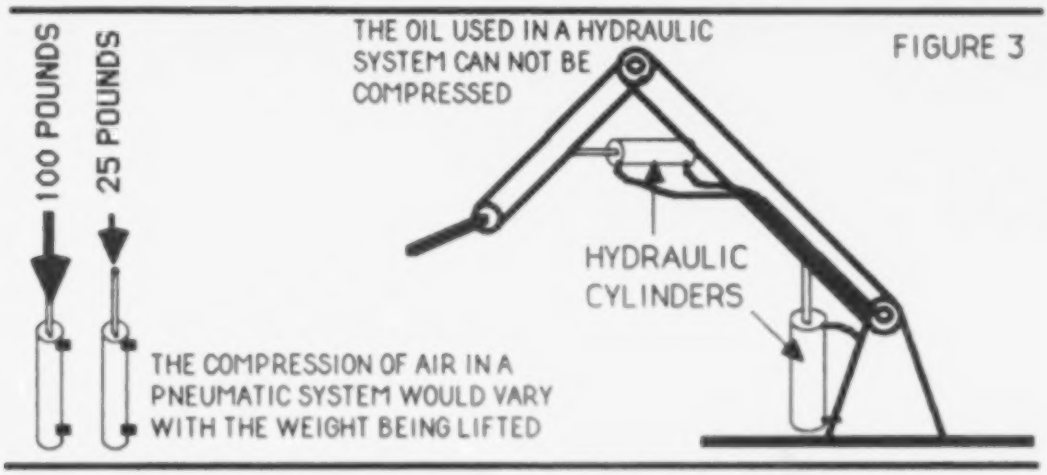
Specialized robots used for security surveillance or warehouse parts retrieval need mobility as well. A variety of sensors have been developed to allow mobile robots to gauge distances, detect the presence of people, avoid obstacles, and follow preprogrammed routes.

ROBOTIC POWER SYSTEMS

The power to move a robot can be provided by electricity, compressed air, or high pressure oil. Each type of power system has its advantages and disadvantages. Combinations of different systems on one robot can use the advantages of different power systems. Repeatable accuracy through computer control are important in all robotic power systems.

Both hydraulic and pneumatic power systems use fluid power.

The fluids used are high pressure oil in a **hydraulic** system, and compressed air in a **pneumatic** system. Fast response and light weight components are benefits of pneumatic control. An air compressor provides the air pressure which can be used to move the piston in a pneumatic cylinder or rotate the vanes in an air motor. If large or very heavy workpieces are to be moved, hydraulics are often used. A hydraulic pump provides very high pressure oil to operate hydraulic cylinders or motors. The compressibility of air in a cylinder when varying weights are lifted often make pneumatic power less desirable than the incompressibility of oil in a hydraulic system. Figure 3 illustrates the use of hydraulic power in robotics.


100 POUNDS
25 POUNDS
THE OIL USED IN A HYDRAULIC SYSTEM CAN NOT BE COMPRESSED
HYDRAULIC CYLINDERS
THE COMPRESSION OF AIR IN A PNEUMATIC SYSTEM WOULD VARY WITH THE WEIGHT BEING LIFTED
FIGURE 3

Electric **stepper motors** turn a shaft a very small amount or 'step' with each pulse of electricity. The movement or positioning of a robot can be controlled with a computer by counting the number of steps sent to each motor. Very accurate control of each part of the robot are possible using stepper motors. Once the host computer has been programmed for the number of steps each motor is to move, the program can be run with repeatable accuracy. A robot programmed to do a pick-and-place maneuver, for example, can repeat the task many times without drifting off course.

Another method of classifying industrial robots is according to the type of computer control. There are four basic types of microprocessor controllers used to program robots to be able to repeatedly perform industrial tasks.

TRACKING- The computer keeps track of robot movement as an operator "trains" it to perform a task.

SEQUENTIAL- Instructions are sent to the robot in a predetermined order from the controlling computer.

REGISTRATION- Allows the operator to "train" the robot by trial and error positioning until the exact position is reached and recorded into the controller's memory.

INFORMATIONAL- Controlling information is entered in the form of mathematical data into the controlling computer.

Some industrial robots can be programmed using a combination of the methods above or can be switched from one mode to another. Many robots have the ability to be programmed from the keyboard of the host computer or from a hand-held **teach control unit**. The controller is often connected to a **positioning table** that can accurately position workpieces for assembly, welding, or some other robotic application. Jigs or fixtures used to hold workpieces and/or guide tools are bolted to the positioning table which rotates under computer control. In this way, an operator can place a workpiece on one side of the positioning table while the robot is welding or assembling the workpiece on the other side. Increased worker safety and improved productivity are direct benefits of this application of robotics. Productivity increases of from 60% to 860% have been realized.

The end effector of a robot can be interchanged to perform a variety of tasks. A gripper is used to perform pick-and-place maneuvers, assemble parts, manipulate hazardous materials, etc. A wire-fed arc welding attachment can be substituted for a gripper for fast and accurate fastening applications. Other robot applications include spray painting, spot welding, tool changing, glue application, grinding, sanding, and many machining operations.

It is often the case that the best person to program a robot for a specific application is an expert in the task. A spray painter, welder, or machine operator would be well suited to train a robot

or judge the performance of the robot. By retraining skilled workers to work with robots, production can be greatly increased without loss of jobs. Future manufacturing operations, however, will require fewer people to operate machines.

ROBOT PROGRAMMING

The actual programming of many industrial robots is not difficult to master. Registration type robots are trained by manipulating the arm to the desired position and recording it. Common jobs such as robot spray painting can easily be accomplished by moving the spray end effector through the movements to complete the painting of a product such as a car or refrigerator. The position of each joint of the robot arm is recorded as the operator 'trains' the robot and recorded on magnetic tape or disk. As design changes take place or different products move down the production line, a different program can be loaded. Figure 4 illustrates the teach control unit of a robot and the functions of various keys.

A typical program to pick up a workpiece and place it in a predetermined location called a pick-and-place maneuver would be as follows:

STEP	POSITION / ACTION	KEYS TO PRESS	
0	INITIALIZE HOME (START) POSITION	(REC)	
1	OPEN GRIPPER	(G)	(REC)
2	MOVE LEFT	(B)	(REC)
3	MOVE DOWN	(S)	(REC)
4	CLOSE GRIPPER ON OBJECT	(G)	(REC)
5	MOVE UP	(S)	(REC)
6	MOVE RIGHT	(B)	(REC)
7	MOVE DOWN	(S)	(REC)
8	OPEN GRIPPER	(G)	(REC)
9	MOVE UP TO CLEAR OBJECT	(E)	(REC)
10-52	NULL		

The program could then be run by pressing the **MODE** and **REC**ord key. The logical movement of the arm quickly becomes second nature for beginning operators. The listing of robot programs such as this is very similar to listing a BASIC program. Very sophisticated robot programming is possible by using the other programming statements available. One of the most powerful of the programming statements available to the robot programmer is the

JUMP command. This allows the robot to make a decision much similar to the **IF-THEN** statement in a BASIC program. When a JUMP statement is encountered by the microprocessor, it can check for various conditions and react accordingly. For example, if a JUMP statement were to be included in the program above, the microprocessor could be programmed to check if the gripper was open or closed, or check for external input from sensors attached to the robot. The JUMP statement gives the robot the ability to go to other steps in the program based on the conditions set. By combining the JUMP and other statements, robots can be programmed to perform very complicated operations. The robot can gauge the size of objects, move workpieces to a station, wait for a completed operation, and move on to the next station.

HOST COMPUTER CONTROL

The control of a robot can be determined by control unit operation, or host computer signals. Robot programming can be written in a form of BASIC or in other computer languages. The "@" character is used in some systems to distinguish robot commands. A partial list of robot commands and their action include:

- **CLOSE**- closes gripper until microswitch is activated
- **QDUMP**- uploads program from robot to host computer
- **WRITE**- downloads a program from host computer to robot
- **READ**- reads the values of internal registers
- **RESET**- turns off power to the motors and zeros registers
- **SET**- sets speed or arm movement
- **STEP**- input values representing amount of movements

The future of robotics is not known. What is known is that robots will play a very important role in both the home and factory of the near future. Commercial robots are available today for home use. Their capabilities include voice synthesis, vacuum cleaning, intruder alarms, distance sensing, etc.

TECHNICAL TERMS

Robot
Host Computer
Teach control
Gripper
Tracking
Sequential
Registration
Informational

Slave manipulator
End effector
Jump
Hydraulic
Positioning table
Stepper Motor
Pick-and-place
Pneumatic

REVIEW QUESTIONS

A. Completion

1. The fact that a robot can be _____ makes it different from an automatic machine.

2. Early slave manipulators were developed to handle _____.

3. The general term for the attachment at the end of a robot arm is _____.

4. The type of industrial robot that allows the operator to train it by trial and error positioning is called _____.

5. _____ , _____ , and _____ are three different types of industrial robot power supplies.

6. The use of high pressure oil in a cylinder is an example of a _____ system.

7. A _____ or a _____ are possible end effectors for various industrial robotic applications.

8. A _____ is often the best suited person to train a robot for a specific task.

9. The _____ command allows robots to make a decision based on position or external input.

10. Common industrial robotic applications include _____ , and _____.

B. Multiple Choice

1. Which type of robot keeps track of arm movement as it is being trained?
   a. sequential
   b. tracking
   c. informational
   d. registration

2. Which type of robot requires controlling information to be entered in the form of mathematical data?
   a. sequential
   b. tracking
   c. informational
   d. registration

3. Which type of industrial robot sends controlling data in a predetermined order?
   a. sequential
   b. tracking
   c. informational
   d. registration

4. Which type of industrial robot records each movement of the arm as the operator trains it?
   a. sequential
   b. tracking
   c. informational
   d. registration

5. Which type of robot power supply is best suited for lifting very heavy workpieces?
   a. electrical
   b. pneumatic
   c. hydraulic
   d. mechanical

6. Which type of robot power supply is easiest to control by computer microprocessor?
   a. electrical
   b. pneumatic
   c. hydraulic
   d. mechanical

7. Which type of robot power supply offers fast response and light weight components?
   a. electrical
   b. pneumatic
   c. hydraulic
   d. mechanical

8. What would be an appropriate power supply category for early slave-manipulators?

a. electrical
b. pneumatic
c. hydraulic
d. mechanical

9. Which robot workstation component uses jigs and fixtures to hold a workpiece or guide a tool?

a. control unit
b. positioning table
c. microprocessor
d. teach control unit

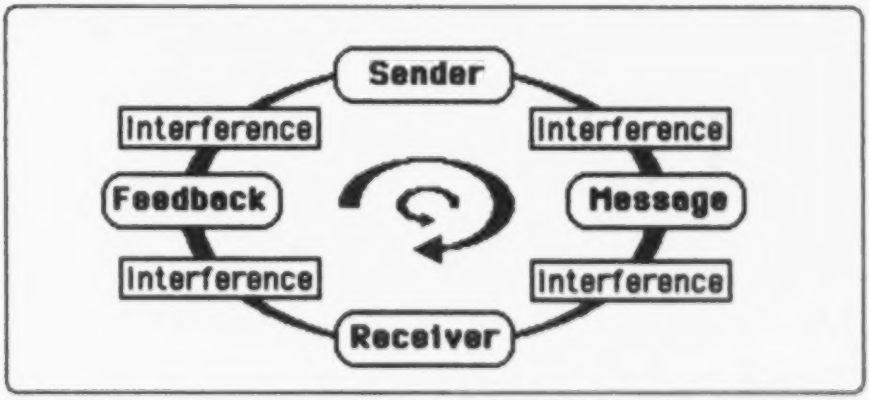
10. Which key should be pressed to close or open the gripper as illustrated by the teach control unit in figure 1?

a. **B**
b. **P**
c. **G**
d. **S**

Appendix D:

Communications Model

The process of communication can be represented graphically by presenting the following models. The simplified version can be used as an introduction to the conceptual model or as an introduction for junior high students.

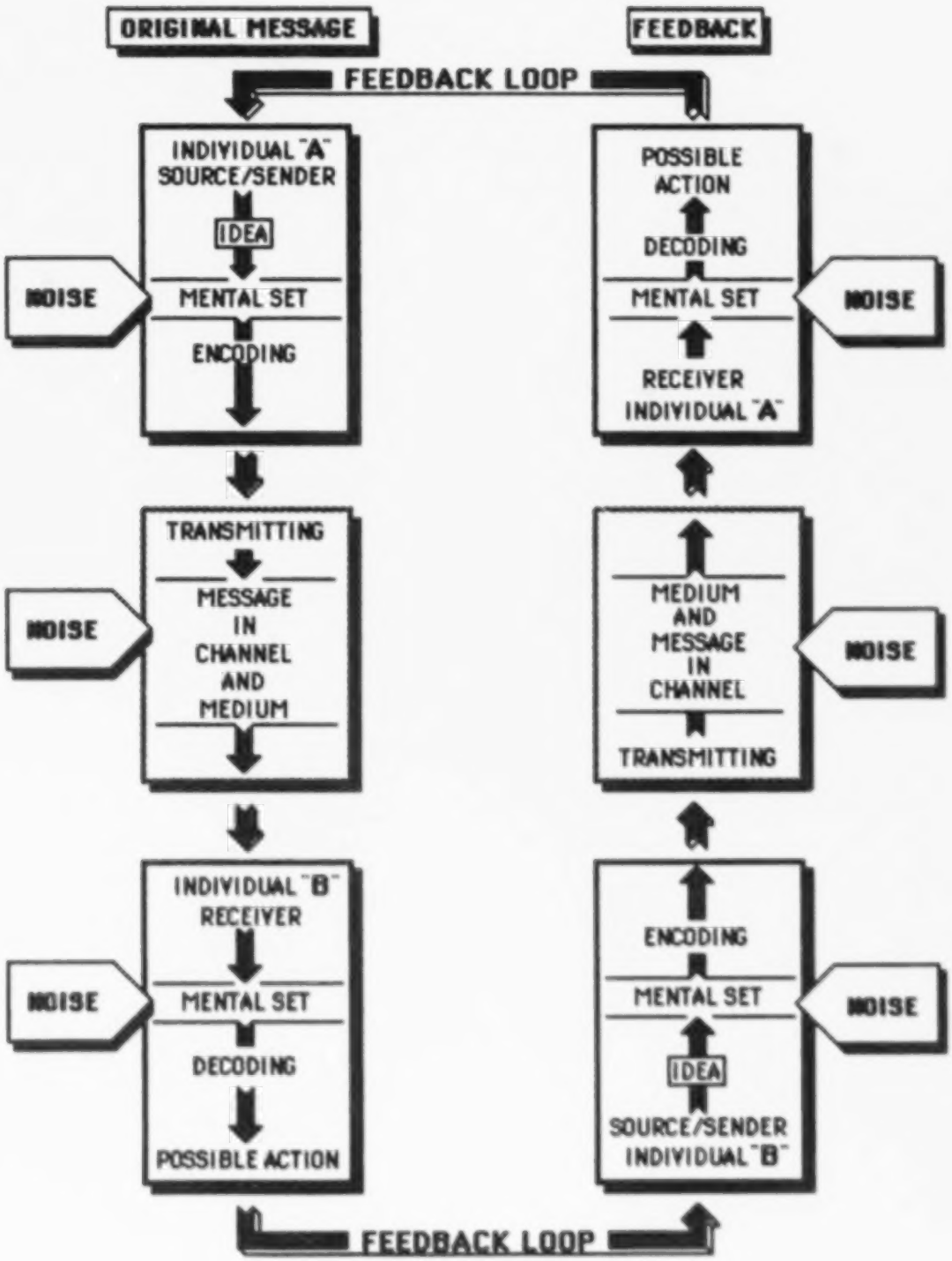


The concept illustrates a sender having a message to communicate to a receiver, trying to avoid any form of interference, and providing feedback to ensure the proper interpretation of the original message.

Many other factors influence the communication process. A more complete model which illustrates the complexity of the communications process is presented on the next page. If the term "noise" is substituted for "interference," students can quickly grasp the concept.

Activities related to understanding the communications model can include:

- Use inexpensive "walkie-talkies" in an assignment in which students must communicate a graphic image from one room to another by describing the design.
- Use a computer/modem combination to have students communicate with other technology education students in other schools.
- Have students develop a simple graphic language in an attempt to communicate a message.


ORIGINAL MESSAGE
FEEDBACK
FEEDBACK LOOP
INDIVIDUAL "A"
SOURCE/SENDER
IDEA
NOISE
MENTAL SET
ENCODING
POSSIBLE
ACTION
DECODING
MENTAL SET
NOISE
RECEIVER
INDIVIDUAL "A"
TRANSMITTING
NOISE
MESSAGE
IN
CHANNEL
AND
MEDIUM
MEDIUM
AND
MESSAGE
IN
CHANNEL
NOISE
TRANSMITTING
INDIVIDUAL "B"
RECEIVER
NOISE
MENTAL SET
DECODING
POSSIBLE ACTION
ENCODING
MENTAL SET
NOISE
IDEA
SOURCE/SENDER
INDIVIDUAL "B"
FEEDBACK LOOP

Appendix E:

Technology Education Activities

The following photographs illustrate some of the equipment and activities associated with the implementation of technology education.